Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Department Specific Course (DSC) as Major

Semester V course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V

SUBJECT – CHEMISTRY (Major – DSC V)

B.Sc. Semester V (NEP)

UCH350T: (Principles of Inorganic Chemistry)

[60 Hrs.] **[4 Credits]**

Course Description:

This course is designed to give learners the knowledge of statistical analysis and core topics of inorganic and analytical chemistry. The statistical method of analysis will help learners to analyze and interpret large datasets from experiments and other analytical techniques. The inorganic chemistry units focus on metal ligand bonding in transition metal complexes and the study of electronic and magnetic properties and kinetics of transition metal complexes. The course will also cover the study of important separation techniques viz. Chromatography, Ion-exchange, and solvent extraction techniques. The chemistry of organometallic compounds, metal carbonyls, inorganic polymers, bioinorganic chemistry, and Pearson's HSAB Concept is also emphasized.

Course Objectives:

1. To learn important basic concepts in statistical analysis of the data.
2. To study metal ligand bonding in transition metal complexes with respect to crystal field theory and understand splitting of d-orbital in octahedral, tetrahedral, and square planar complexes along with electronic spectra.
3. To understand magnetic properties and kinetics of transition metal complexes.
4. To study the principles and applications of important separation techniques viz. Chromatography, Ion-exchange, and solvent extraction techniques.
5. To study the chemistry of organometallic compounds, metal carbonyls, and inorganic polymers.
6. To understand Bioinorganic Chemistry, roles of essential and trace elements in biological processes and to study Pearson's HSAB Concept and its applications.

Course Outcomes: -

On completion of this theory course, students will be able to-

1. Apply statistical methods for chemical analysis and interpret the results.
2. Predict the crystal field splitting of d-orbitals, geometry and electronic spectra of various transition metal complexes.
3. Analyze the magnetic properties and kinetic stability of complexes.
4. Apply various separation techniques viz. Chromatography, Ion-exchange, and solvent extraction techniques for separation of chemicals.
5. Identify organometallic compounds, metal carbonyls, and inorganic polymers and illustrate its applications.

6. Analyze the importance of essential and trace elements in biological processes and apply HSAB concept.

Contents:

Unit – I **[10 hrs]**

Errors in Chemical Analysis:

Errors in Chemical Analysis, Types of errors, Systematic and Random errors, Explanation of terms: Accuracy and Precision, Uncertainty, Absolute and Relative errors, Mean, Median, Average and Standard deviations, Numerical problems, Significant figures, Statistical Test of Data: Q-test, 2.5d and 4d Rules for rejection of data. Numerical problems

Unit – II **[10 hrs]**

A) Metal ligand bonding in Transition Metal Complexes:

Limitations of Valency bond theory, Crystal field theory: Splitting of d-orbital in octahedral, tetrahedral, and square planar complexes. Factors affecting the Magnitude of 10Dq, Crystal Field Stabilization Energy of Octahedral and Tetrahedral complexes (Numericals).

B) Electronic spectra of Transition Metal Complexes:

Jahn Teller Effect, Selection Rules (Laporte and Spin selection Rules). Hole Formalism Principle. Electronic spectrum of $[Ti(H_2O)_6]^{3+}$ and $[Cu(H_2O)_6]^{2+}$ complex ions

Unit – III **[10 hrs]**

A) Magnetic Properties of Transition Metal Complexes:

Magnetism, Types of magnetism, diamagnetism, paramagnetism, ferromagnetism, and antiferromagnetism, Magnetic Properties of Transition Metal Complexes, Method of determining Magnetic Susceptibility by Gouy's Method. Spin only formula and orbital contribution to magnetic moment. Magnetic properties of Octahedral and Tetrahedral complexes with respect to CFT. Numericals on magnetic moments

B) Thermodynamic and Kinetic aspect of Metal Complexes:

Thermodynamic and Kinetic stability of metal complexes, their relation. Stepwise stability and overall stability constant and their relationship, Factors affecting the Stability of complexes. Determination of composition of Fe(III)-SSA complex by Mole Ratio and Job's Method.

Unit – IV **[10 hrs]**

Separation Techniques:

A) Chromatography: Classification, Principle, Technique and Application of Paper and Column Chromatography. Numericals.

B) Ion- Exchange: Types of ion exchange resins, Equilibria and ion exchange capacity, Application in separation of binary mixtures. Numericals.

C) Solvent Extraction: Principle and Classification, Factors influencing extraction and application in chemistry. Numericals.

Unit – V **[10 hrs]**

A) Organometallic Chemistry

Definition, Nomenclature and Classification of Organometallic compounds. Preparation properties and application of Alkyl and Aryls of Li and Al. A brief account of metal ethylenic complexes (Structure only). Homogeneous Hydrogenation (Wilkinson's Catalyst reaction).

B) Metal carbonyls-Definition, preparation, properties, structure and bonding in mononuclear carbonyls-$Ni(CO)_4$, $Fe(CO)_5$ and $Cr(CO)_6$

C) Inorganic Polymers:

Silicones: Introduction, Nomenclature, preparation, properties and uses, General introduction to Silicon oils, Silicone Elastomers and Silicon Resins

Phosphonitrilic halide polymers: Introduction, Preparation, properties and uses. Structure and bonding in $(NPCl_2)_3$ and $(NPCl_2)_4$

Unit - VI

A) Bioinorganic Chemistry: Essential and Trace elements in biological processes, Metalloporphyrins with special reference to structure and role of Hemoglobin and Myoglobin in transport of Oxygen. Biological role of Na^+ and K^+ and Ca^{2+} metal ions.

B) Hard and Soft Acids and Bases: Classification of Acids and Bases as Hard and Soft. Pearson's HSAB Concept and its applications, Symbiosis

References:

- Lee, J.D. *Concise Inorganic Chemistry,* ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
- Puri, Sharma, Kalia. *Principles of Inorganic Chemistry*.
- Gary D. Christian, Analytical Chemistry: (Wiley, India).
- Willard, Merrit, Dean, Settle, Instrumental Methods of Analysis: (CBS Publishers, Delhi)
- Braun, Instrumental Methods of Chemical Analysis: (Tata McGraw-Hill)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V

SUBJECT – CHEMISTRY (Major – DSC V)

B.Sc. Semester V (NEP)
UCH350P: (Inorganic Chemistry Practical)

[60 Hrs.] **[2 Credits]**

Course Description:

The course will impart important practical and analytical skills to the learners. They will gain skills to perform scientific experiments like qualitative and quantitative analysis of samples with precision. They will be able to interpret the experimental data and to improve analytical skills. The learners will develop skills to qualitatively analyze given inorganic mixture and organic compound by non-instrumental methods. They will be able to systematically identify the group of radicals and then confirm the presence of certain acidic and basic radicals.

Course Objectives:

The primary objective of the practical course is to learn to perform experiments with specific aims and correct techniques.

1. To verify and apply the concept of Beer-Lambart's law.
2. To determine the composition of complexes using different methods.
3. To learn analytical skills of separation techniques.
4. To learn to detect acidic basic radicals from given unknown mixture of inorganic salts.

Course Outcomes:

On completion of the practical course students will be able to-

1. Apply the concept of Beer-Lambart's law.
2. Determine the composition of complexes using different methods.
3. Apply analytical skills of separation techniques.
4. Demonstrate skills in semi-micro qualitative analysis inorganic compounds and detect acidic and basic radicals from given unknown mixture of inorganic salts.

Contents:

A) Inorganic Chemistry

1. To verify Beer-Lambert's law and determine the concentration of given unknown $KMnO_4$ solution.
2. To estimate Copper (II) in commercial copper sulphate sample as ammonia complex using colorimeter or spectrophotometer.
3. To determine composition of Fe- SSA complex by Job's method.

4. To determine composition of Fe- SSA complex by Mole Ratio method.
5. Chromatographic separation of binary mixtures (at least Two) containing Cu(II), Co(II) and Ni (II) ions by paper chromatography and determination of Rf values.
6. To study the distribution of benzoic acid between water and benzene

B) Semi micro–Qualitative Analysis

Qualitative analysis of inorganic salt mixture containing two acidic radicals of different groups and two basic radicals of different groups. (At least eight mixtures to be analyzed).

References:

- Vogel's Textbook of Quantitative Inorganic Analysis-Bassett, Denney, Jeffery and Mendham (ELBS).
- Practical Inorganic Chemistry - Pass
- Practical Inorganic Chemistry - Marr and Rocket
- Synthesis and characterisation of Inorganic Compounds – W. L. Jolly, Prentice Hall
- Experimental Inorganic Chemistry7 – W.G. Palmer, Cambridge
- Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education.
- Analytical Chemistry: Gary D. Christian (Wiley, India).
- An Introduction to Separation Science: L. R. Shyder and C. H. Harvath (Wiley Interscience)
- Practical Inorganic Chemistry – G. Marrand, B.W. Rockett, Van Nostrand

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V

SUBJECT – CHEMISTRY (Major – DSC VI)

UCH355T: (Principles of Physical Chemistry)

[60 Hrs] **[4 Credits]**

Course Description: -

The purpose of this course is to equip learners with the knowledge of core topics of physical chemistry. The physical chemistry units are designed to cover important topics such as chemical kinetics, adsorption, catalysis and electrochemistry with a focus on conductance and EMF measurements. The basic concepts of advanced topics such as quantum chemistry, photochemistry and nuclear chemistry are also included in this course.

Course Objectives: -

1. To study the fundamentals of chemical kinetics and extend the study to the theories of reaction rates.
2. To study important topics of surface chemistry i.e. adsorption and catalysis through thermodynamics, adsorption isotherms and theories of catalysis.
3. To understand important concepts related to electrolytic conductance and to study its applications in determination of important electrochemical properties and volumetric titrations.
4. To understand the concept of EMF of cell and its applications.
5. To introduce the concepts and methodology of quantum mechanics.
6. To make students understand the laws of photochemistry and their application along with important basics of nuclear chemistry and its applications.

Course Outcomes: -

On completion of this theory course, students will-

1. Gain in-depth knowledge of reaction dynamics with respect to rate law and rate of reaction, theories of reaction rates.
2. Understand the fundamentals of adsorption and apply them to study catalysis.
3. Measure electrolytic conductance and use it for quantitative analysis and determination of dissociation constant and solubility product.
4. Construct electrochemical cells, write cell reactions, calculate their thermodynamic parameters, determine and use EMF values for analytical applications.
5. Understand the basic principles and terminologies of quantum mechanics and apply these basics to study simple systems.
6. Explain low and high quantum yield and their causes; demonstrate Jablonski diagram, write mechanisms of photosensitized reactions.
7. Apply the concepts of nuclear chemistry to determine nuclear stability, illustrate the applications of radioisotopes in various fields.

The topics of this course cover mainly the core concepts of physical chemistry.

Contents: -

Unit I: Chemical Kinetics **(10 Hrs)**

A. Concept of reaction rate, factors affecting the rate of a reaction – concentration, temperature, pressure, surface area, light, catalyst. Order and molecularity, zero order reactions. Mathematical expression for rate constant of first and second order reactions ($a = b$ and $a \neq b$), their characteristics. Pseudo order reactions. mean life of reactions with examples. Methods of determination of order of reaction – integration method, differential method, graphical method, method of half-life period and Ostwald's isolation method. Effect of temperature on rate of reaction. Arrhenius equation and its derivation, concepts of activation energy. Numericals.

B. Collision theory of bimolecular reactions (hard sphere model). Transition state theory, expression for rate constant based on equilibrium constant and thermodynamic aspects.

Unit II: **Adsorption and Catalysis** **(10 Hrs)**

(A) Adsorption- General introduction, Thermodynamics of adsorption, Types of adsorption, Factors affecting adsorption of Gases by Solids, Adsorption Isotherms: Freundlich Adsorption Isotherm, Langmuir Adsorption Isotherm, B.E.T. Equation (derivation not expected), Application of B.E.T. equation in the determination of Surface Area of Adsorbent (Numerical), Application of Adsorption.

(B) Catalysis: - Introduction, Homogeneous & Heterogeneous Catalysis, Auto catalysis Examples, Action of Catalytic Promoters & Inhibitors, Activation energy and catalysis, Theories of catalysis i) Intermediate compound formation theory ii) Adsorption theory, Active centre on catalyst surface, Adsorption theory and catalytic activity, Acid – Base catalysis (theoretical aspect only) and its industrial applications.

Unit III: Electrochemistry I **(10 Hrs)**

A) Electrical transport: electronic and electrolytic conductors, resistivity, conductance, specific resistivity, specific conductance, molar conductance and equivalent conductance, measurement of conductance of solutions, conductometer, conductivity cell, cell constant, Variation of equivalent & specific conductance with dilution, Arrhenius theory of electrolyte dissociation & its limitation, Debye-Huckel theory (elementary treatment).Relaxation effect, Electrophoretic effect and Onsagar equation. Numericals.

B) Concept of Transport number, relation between transport number & ionic conductance, factors affecting transport number of ions & its determination by moving boundary method. Kohlrausch's law, application of Kohlrausch's law & conductance measurement for the determination of degree of dissociation & dissociation constant of acids, solubility of sparingly soluble salt, numerical. Conductometric titration curves in the titration of: (i) strong acid vs. strong base (ii) weak acid vs. strong base (iii) weak acid vs. weak base (iv) mixture of strong and weak acids vs. strong base (v) sodium chloride vs. silver nitrate (vi) barium hydroxide vs. magnesium sulphate. Advantages and limitations. Numericals.

Unit IV: Electrochemistry II **(10 Hrs)**

(A) Introduction to Electrolytic cell and Electrochemical cell (Galvanic /Voltaic cell), Cell representation of galvanic cell from cell reactions and vice versa, reversible & irreversible cells, Concept of EMF of a cell & Measurement of EMF of a cell, calculation of thermodynamic quantities of a cell reactions (ΔG, ΔH, ΔS & equilibrium constant), Derivation of Nernst equation for the EMF of a cell and hence for a single electrode potential. Numericals.

(B) Types of reversible electrodes: gas electrode, metal-metal ion electrode, amalgam electrode, metal insoluble salt-anion, redox electrodes, Half-cell reactions, calculation of cell EMF from single electrode potential, reference electrodes, standard electrode potential, liquid-junction potential, salt bridge & its functions, Applications of EMF measurements in pH-determination using hydrogen electrode, quinhydrone electrode & glass electrode. Potentiometric titration curves for: (i) Strong Acid vs. Strong Base (ii) Weak Acid vs. Strong Base (iii) Redox Titration. Numericals.

Unit V: Quantum Chemistry **(10 Hrs)**

A) Basics of Quantum mechanics: Introduction to wave functions (Ψ), well behaved and acceptable wave functions. Interpretation of wave function (Ψ) and its square (Ψ^2), Normalized and orthogonal wave functions (only qualitative idea no problems), Introduction to operators, Linear operator, Hermitian operator, Addition, subtraction and multiplication of operators, commutative and non- commutative operators, position, momentum and energy operators. Eigen function and eigen value, eigen value equation. Numericals.

B) Schrodinger wave equation and its applications: Postulates of quantum mechanics, Derivation of Schrodinger wave equation from postulates of quantum mechanics. Application of Schrodinger wave equation to Particle in one-dimensional box: derivation of energy and normalized wave function. Graphical representation of Ψ and its square (Ψ^2). Applications of particle in one-dimensional box, Numericals.

Unit VI: Photochemistry and Nuclear Chemistry **(10 Hrs)**

(A) Photochemistry: Interaction of radiation with matter, difference between thermal and photochemical process, Beer–Lambert's, laws of photochemistry: Grothus-Draper law, Stark Einstein law, Jablonski diagram depicting various processes (radiative and non-radiative) fluorescence, phosphorescence, chemiluminescence, quantum yield, determination of quantum yield of reactions, causes for low and high quantum yields. Some examples of photochemical reactions e.g. photochemical decomposition of Hydrogen iodide, photosynthesis of HBr from H_2 and Br_2 and photosynthesis of HCI from H_2 and Cl_2.

(B) Nuclear Chemistry: Important terms in nuclear chemistry: Isotope, Isobar, Isotone, Mass defect, nuclear binding energy, Average binding energy per nucleon, Numericals. Nuclear reactions: Fission and fusion. Applications of radioisotopes in medicine, agriculture, carbon dating and structure determination.

Reference Books:

1. K. J. Laidler, *Chemical Kinetics*, Third Edition (1987), Harper and Row, New York.
2. J. Raja Ram and J. C. Kuriacose, *Kinetics and Mechanism of Chemical Transformations* MacMilllan Indian Ltd., New Delhi (1993)
3. C. H. Bamford and C. F. H. Tipper, *Comprehensive Chemical Kinetics, Vol 1*, Elsevier Publications, New York, 1969.
4. C. H. Bamford and C. F. H. Tipper, *Comprehensive Chemical Kinetics, Vol 2*, Elsevier Publications, New York, 1969.
5. Santosh Kumar Upadhyay, *Chemical Kinetics and Reaction Dynamics*, Springer 2006
6. Donald A. McQuarrie, Quantum Chemistry
7. Ira Levine, Quantum Chemistry
8. K. K. Rohatagi and Mukherjee , Fundamentals of Photochemistry, Third Edition, New Age Publishers
9. H. J. Arnikar, Essentials of Nuclear Chemistry Fourth Edition, New Age International Publishers
10. P. W. Atkins'and D. Paula, *Physical Chemistry*, 8th Edition, Oxford University Press, 2010
11. S. H. Marron and C. F. Pruton. *Principles of Physical Chemistry*,4th edition
12. Samuel Glasstone. *Textbook of Physical Chemistry*,
13. Ira Levine, *Physical Chemistry*, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.
14. G. M. Barrow, *Physical Chemistry*, 6th Edition, TMH Publishing Co. Ltd. New Delhi.
15. Puri, Sharma, Pathania, *Principles of Physical Chemistry,* Vishal Publishing Co., 2020
16. Soni P. L., Dharmarha O. P., Dash U. N., *Textbook of Physical Chemistry,* Sultan Chand and Sons, 2016.
17. B.S. Bahl, G.D.Tuli and Arun Bahl, *Essentials of Physical Chemistry,* S. Chand and Company Ltd.
18. K. L. Kapoor, Physical Chemistry, Volume 1-4

e References

- e-PGPathshala (inflibnet.ac.in)
- http://nsdl.niscair.res.in
- http://ocw.mit.edu

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V

SUBJECT – CHEMISTRY (Major - DSC VI)

UCH355P: Physical Chemistry Lab Course

[60 Hrs] **[2 Credits]**

Course Description: -

The purpose of this course is to inculcate basic practical skills among the learners. They will learn to perform experiments of specific aims with correct techniques. They will be able to correlate theory with practical. They will apply the theoretical knowledge to study reaction kinetics, adsorption isotherms, conductance, EMF and optical rotation.

Course Objectives: -

The primary objective of the practical course is to learn to perform both instrumental and non-instrumental experiments with correct techniques.

1. To study rate and to determine rate constant and activation energy of certain reactions
2. To verify the Freundlich and Langmuir adsorption isotherms.
3. To apply principles of electrochemistry to perform conductometric titrations, to determine the solubility and solubility product of a sparingly soluble salt and to determine the ionization constant of weak acid.
4. To perform quantitative analysis using potentiometric titrations and to set up redox electrodes for calculating redox potentials.
5. To use polarimeter for determining optical rotation.

Course Outcomes: -

On completion of the practical course students will-

1. Gain an understanding of methods to determine kinetic parameters of reactions like rate of reaction, rate constant, energy of activation.
2. Learn to verify Freundlich and Langmuir adsorption isotherms.
3. Apply the methods to determine conductance of electrolytic solutions and use the conductance values for different applications.
4. Monitor EMF of electrochemical cells and use the EMF values for different applications.
5. Determine the optical rotation of given sample.

Course Contents: -

1. To determine the specific reaction rate of the hydrolysis of methyl acetate catalyzed by H^+ ions at room temperature.
2. To determine the specific reaction rate of hydrolysis of ethyl acetate catalyzed by base (saponification)
3. To study the rate of acid catalyzed iodination of acetone.

4. To determine the energy of activation of reaction between persulphate and iodide
5. To Study the kinetics of iodine clock reaction.
6. To verify the Freundlich adsorption isotherm of acetic acid on charcoal.
7. To verify the Langmuir's adsorption isotherm of acetic acid on charcoal.
8. To determine the cell constant of a conductivity cell.
9. To determine the strength of the given strong acid conductometrically using standard alkali solution.
10. To determine the strength of the given weak acid conductometrically using standard alkali solution.
11. To determine the strength of strong acid and a week acid in a given mixture conductometrically by titrating it with standard alkali solution.
12. To determine the solubility and solubility product of a sparingly soluble salt conductometrically.
13. To determine the ionization constant of weak acid conductometrically.
14. To determine the strength of the given strong acid (HCl) potentiometrically using standard alkali solution.
15. To determine the strength of the given weak acid (CH_3COOH) potentiometrically using standard alkali solution.
16. To titrate potentiometrically ferrous ammonium sulphate solution using potassium dichromate solution as titrate and calculate the redox potential of Fe^{2+}/Fe^{3+} system on hydrogen scale.
17. To determine the specific rotation of a given optically active compound.

Reference Books:-

1. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
2. Vogel, A. I., Tatchell, A.R., Furnis, B. S., Hannaford, A. J. & Smith, P. W. G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
3. Mann, F. G. & Saunders, B. C. *Practical Organic Chemistry* Orient-Longman, 1960.
4. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi, 2011.
5. Yadav J. B., *Advanced Practical Physical Chemistry*, Krishna Prakashan Media (P) Ltd, 2015.
6. http://nsdl.niscair.res.in
7. http://ocw.mit.edu

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Discipline Specific Elective (DSE) of Major

Semester V course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V (NEP)

SUBJECT – CHEMISTRY (Elective – DSE – I - First)

(UCH354T – Modern Chemistry)

[60 Hrs] **[4 Credits]**

Course Description: -

The purpose of this course is to introduce learners with knowledge of modern chemistry of advanced materials like glasses, ceramics, refractories, polymers, composite and nanomaterial. Along with that learners will also gain the knowledge about energy sources like coal, fuels, petrochemical products etc. The study also involves understanding environmental and hazardous issues related to use of chemicals i. e. green chemistry.

Course Objectives: -

1. To learn the chemistry of glasses, ceramics, and refractories.
2. To study the modern polymers and composite materials
3. To understand the chemistry of fuels and coal.
4. To learn the basic chemistry and technology of petrochemicals.
5. To learn the chemistry of nanomaterials.
6. To understand the fundamentals of green chemistry.

Course Outcomes: -

On completion of this theory course, students will-

1. Develop understanding of chemistry of glasses, ceramics, and refractories.
2. Gain in-depth knowledge of modern materials like polymers and composite.
3. Describe chemistry of fuels and coal.
4. Explain basic chemistry and technology of petrochemical industry and products.
5. Describe classification, properties and applications nanomaterials.
6. Gain in-depth knowledge of green chemistry and its applications.

Course Contents: -

Unit I: Glasses, Ceramics, and Refractories (10h)

A. **Glass:** Manufacturing glass, Types of glasses, Structure, properties and applications of glasses.
B. **Ceramics:** Methods of fabrication of ceramic ware, ceramic products, glazes, Porcelain, and vitreous enamels.
C. **Refractories:** Requisites of a Good Refractory, Classification of Refractories, Raw Materials of Refractories, Properties of Refractories, Types of Refractory Products.

Unit II: (10h)

A. **Polymers:** Introduction, Classification of Polymers, Resins and Plastics, Constituents of Plastics, Fabrication of Plastic Articles, Thermoplastic Resins, Thermoset Resins, Biopolymers, Rubbers, Natural Rubber, Synthetic Rubbers.
B. **Composite Materials:** Introduction, Constitution, Classification: (A) Particle-Reinforced, Composites, (B) Fibre-Reinforced Composites, Fibre Glass - Reinforced Composites, Other Fibre-Reinforced Composites, Metal Matrix - Fiber Composites, Hybrid Composites, Processing of Fiber - Reinforced Composites, Structural Composites, Applications of Composite Materials.

Unit III: Fuels and Coal (10h)

A. **Introduction to fuels:** Overview of their significance in energy production. Classification of fuels**:** Solid, liquid, gaseous, renewable, non-renewable. Calorific value**:** Definition, importance, methods, and influencing factors. Criteria for fuel selection: Economic factors, availability, sustainability, environmental impact. Solid fuels: Types and characteristics (wood, peat, lignite, bituminous coal, anthracite).
B. **Coal:** Origin, composition, Indian coal properties, classification, characteristics, and commercial types. Coal derivatives: Coal gas, producer gas, water gas, coal tar, and metallurgical coke. Advanced processing: Coal gasification, liquefaction, solvent refining and carbonization. Uses of coal: Applications as fuel and in various industries for non-fuel purposes.

Unit IV: Petrochemical Industry (10h)

A. History and Importance: Overview of the petrochemical industry's evolution and its global significance, with a focus on growth in India. Classification of Petrochemicals: Categories of petrochemicals and their various applications. Feedstock for Petrochemicals: Types of feedstock including natural gas, naphtha, and gas oil; methods for preparing feedstock through ethane/propane and naphtha/gas oil cracking; production of syngas.
B. **Chemistry and Technology of Petrochemicals:** Production processes for key petrochemicals from C1, C2, C3, C4 compounds, syngas, and aromatics; specific focus on methanol, formaldehyde, ethylene oxide, butene, and cumene. Crude Oil Properties: Examination of crude oil characteristics, including octane number and its importance.

Distillation Processes: Overview of atmospheric and vacuum distillation methods; petroleum products and their quality control tests.

C. **Gaseous Fuels:** Study of the composition and properties of natural gas, synthetic gas, producer gas, water gas, coal gas, LPG, CNG, and hydrogen as alternative fuels.

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Unit V: Nanomaterials (10h)

Introduction, classification, Physical & Chemical Properties, size dependent properties (Surface area, Electrical, Optical and Catalytic properties). Synthesis of nanomaterials: Top down and bottom-up approaches, Synthesis by Sol-gel, and co-precipitation method, Nanoscale materials: Fullerenes, Carbon nanotubes and graphenes –Brief explanation, properties and applications.

Unit VI: Green Chemistry (10h)

Introduction, Education and need of Green chemistry, Basic principles of green chemistry. Concept of atom economy applied to addition, elimination, substitution & rearrangement reaction. Green solvents, Green catalysts, case studied (Bhopal gas tragedy, Minamata disease, Silvasa disaster), Green synthesis of e- Caprolactum, styrene, ibuprofen, paracetomol, hydroquinone & adipic acid.

References:

1) P.C. Jain and Monica Jain, A test Book of Engineering Chemistry, Dhanpat Rai Publications, New Delhi, 12th Edition, 2012.
2) SS Dara & Dr. SS Umare. -A Textbook of Engineering Chemistry, S Chand & Company Ltd., 12th Edition, 2011.
3) R.V. Gadag and Nitthyananda Shetty-A Textbook of Engineering Chemistry, I.K. International Publishing house. 2nd Edition, 2016.
4) B.S. Jai Prakash, R. Venugopal, Sivakumaraiah& Pushpa Iyengar.,- Chemistry for Engineering Students", Subash Publications, Bangalore.5th Edition, 2014
5) F.W. Billmeyer, Text Book of Polymer Science, John Wiley & Sons, 4th Edition, 1999.
6) C. V. Agarwal, C. P. Murthy, A. Naidu, "Chemistry of Engineering Materials", Wiley India, 5th Edition, 2013.
7) R. P. Mani, K. N. Mishra, "Chemistry of Engineering Materials", Cengage Learning, 3rd Edition, 2015.
8) G.A. Ozin & A.C. Arsenault, "Nanotechnology A Chemical Approach to Nanomaterials". RSC Publishing, 2005.
9) Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, 2nd Edition, 2010.
10) Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press (1998).
11) Ahluwalia, V.K. & Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers (2005).

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V (NEP)

SUBJECT – CHEMISTRY (Elective – DSE – I – Second)

UCH354T – Industrial Chemistry

[60 Hrs] **[4 Credits]**

Course Description: -

The purpose of this course is to introduce learners to the fundamentals of industrial chemistry. The study involves understanding important industrial gases and chemicals. The learners will gain knowledge about the chemistry of metallurgy, alloys, battery, explosives, cosmetics and perfumes.

Course Objectives: -

1. To learn the fundamental principles and equipment applied in chemical technology.
2. To study important industrial gases and chemicals.
3. To understand the extraction of metals and preparation of alloys.
4. To learn the technology of batteries.
5. To learn the chemistry of explosives.
6. To understand the fundamentals cosmetics and perfume chemistry.

Course Learning Outcomes: -

On completion of this theory course, students will-

1. Develop understanding of important processes and equipment used in chemical industry.
2. Explain importance of industrial gases and chemicals.
3. Describe technology used in batteries.
4. Explain basic chemistry and technology of petrochemical industry and products.
5. Describe the chemistry of explosives.
6. Relate knowledge of chemistry with cosmetics and perfumes..

Contents

Unit I: Chemical Technology **(10h)**

Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption and adsorption. An introduction into the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in chemical industry. Introduction to clean technology.

Unit II: Industrial Gases and Inorganic Chemicals **(10h)**

(a) Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene.

(b) Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

Unit III: Industrial Metallurgy and Alloys (10h)

(a) Industrial Metallurgy: Preparation of metals (ferrous and nonferrous) and ultra-pure metals for semiconductor technology.

(b) Alloys: Classification of alloys, Ferrous and Non-Ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorization) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Unit IV: Battery (10h)

Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Lead- acid Battery, Li-ion Battery, Solid state electrolyte battery. Fuel Cells, Solar cell and polymer cell.

Unit V: Chemical Explosive (10h)

Explosive, General properties of Explosives, Classification of Explosive, Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, pentaerythritol tetranitrate (PETN), cyclonite (RDX). Introduction of rocket propellant. Indian laws related to Explosives.

Unit VI: Cosmetics and Perfumes (10h)

A general study including preparation and uses of the following: Hair dye, hair spray, Shampoo, Sun-tan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone

References:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2. R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
6. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
7. B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meeru

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Vocational Skill Course (VSC)

Semester V course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V (NEP)

SUBJECT – CHEMISTRY (VSC)

U352VSC– Practical Techniques in Fuels, Soil and Material Chemistry

[60 Hrs.] **[2 Credits]**

Course Objectives:

1. To assess the quality of coal by determining its moisture and ash content.
2. To measure the moisture content and organic matter in soil using standard laboratory techniques.
3. To analyze materials like cement and soil through chemical titration and colorimetric methods.
4. To synthesize Bakelite, conducting polymers, and various nanoparticles using methods such as polymerization, precipitation, and sol-gel techniques.
5. To study corrosion control through the process of electroplating.

Course Outcomes:

1. They will understand the importance of moisture and organic content in soil and coal for various applications.
2. Students will gain hands-on experience in the synthesis and characterization of advanced materials.
3. They will develop analytical skills for evaluating material composition and quality.
4. They will be equipped with knowledge applicable in materials science, environmental analysis, and industrial processes.
5. Students will learn practical methods for controlling corrosion in materials.

Course Contents:

1. To determine the moisture and ash content in a given coal sample.
2. To measure the moisture content in a soil sample.
3. To quantify the organic matter content in soil using the Walkley-Black method.
4. To determine the available phosphorus content in soil using Olsen's method.
5. Aim: To estimate the percentage of Fe^{3+} in a cement sample using colorimetry with ammonium thiocyanate as the reagent.
6. To determine the percentage of CaO in a cement sample by complexometric titration with EDTA.
7. To synthesize Bakelite, a thermosetting polymer, through the polymerization of phenol with formaldehyde.
8. To synthesize conducting polyaniline from aniline using chemical oxidative polymerization.
9. To synthesize dibenzalpropanone through an aldol condensation reaction between benzaldehyde and acetone.
10. To synthesize ZnO nanoparticles using a simple precipitation method.

11. To synthesize ZnO nanoparticles using the sol-gel technique.
12. To synthesize iron oxide nanoparticles using a co-precipitation method.
13. To synthesize transition metal oxide nanoparticles using the hydrothermal method.
14. To study the process of electroplating copper onto an iron object as a method of corrosion control.

References:

1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2.R.M. Felder, R.W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
4. S. S. Dara: A Textbook of Engineering Chemistry, S. Chand & Company Ltd. New Delhi.
5. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
6. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
7. B. K. Sharma: Engineering Chemistry, Goel Publishing House, Meeru

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Field Project (FP) of Major

Semester V course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester V (NEP)

SUBJECT – CHEMISTRY (Field Project)

UCH359 – Field Project

[60 Hrs.] **[2 Credits]**

As per NEP 2020, students of BSc Semester V (Third Year-First Semester) students need to perform a Field Project (FP) for **TWO (2) Credits** i.e. **50 Marks**. The guidelines regarding the field project are as follows:

1) The total time allocation for the student to carry out field project is 60 hours. The actual fieldwork should be carried out after college hours or on holidays or during winter vacation.
2) Students should participate in field-based projects under the supervision of faculty.
3) A minimum of 30 hours of work per credit is required in a semester.
4) Assignment of project topics to individual students or groups of students (3 or 4 students in one group) and one faculty member from the department will act as GUIDE for the student or group of students.
5) For a SURVEY based project topic a questionnaire (20 or more questions) (English) related should be prepared.
6) The departmental coordinator/guide should check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative.
7) If the project is related to work that does not involve SURVEY work, then the questionnaire part can be replaced accordingly (e.g. Sample collection/Data collection).
8) Students should go to their chosen field with the questionnaire and collect the information regarding the questions asked to the concerned people or collect samples/data. Collect as much information/samples/Data as possible by collecting. The more the data, the better it will be for analysis.
9) The student should compile all the relevant data and carry out its analysis.
10) A project report should be written individually in the standard format (2 Copies): Index, Chapter-1, Chapter-2, ….. Conclusion, References etc.
11) The report should mention the clear OUTPUT drawn from the study. The typed project report should have a minimum of 12 pages (excluding Title, Certificate, Index, Acknowledgement etc. pages) in Times New Roman with font size 12 and line spacing of 1.5. 9.
12) Submit the project report with the Guide's signature to the department (To the Departmental FP coordinator).
13) The Oral presentation for all the projects in the department should be arranged in the department. To evaluate the project, TWO examiners should be appointed by HoD (The details about appointment of examiners, weightage to internal and external marks etc. will be provided by the examination section).

14) The total project work including preparation of questionnaire to oral presentation should be evaluated for 2 credits (50 Marks).
15) The departmental FP coordinator/PG coordinator/HoD should submit the marks as per regular procedure to the examination section.
16) The scheme of examination for field project is given below –

Sr. No	Evaluation type	Marks
1	Presentation	15
2	Report	25
3	Certificate	10
Total Marks		**50**

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Department Specific Course (DSC) as Major

Semester VI course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI (NEP)

SUBJECT – CHEMISTRY (Major – DSC VII)

UCH360T: (Principles of Organic Chemistry)

[60 Hrs] **[4 Credits]**

Course Description: -

The purpose of this course is to introduce learners with knowledge of chemistry of organometallic reagents, heterocyclic compounds, biomolecules, surfactants, synthetic drugs, dyes and polymers. The study mainly involves structural information, classifications, synthesis, properties, and chemical reactions of these compounds. Chemistry of biomolecules includes basics of carbohydrates, amino acids, proteins, peptides, nucleic acids, enzymes, oil and fats as they are important back bones of our life.

Course Objectives: -

1. To learn the chemistry of organometallic compounds and amines.
2. To study the structure, syntheses, and reactions of the simple 5 and 6-membered ring heterocycles, the benzene ring fused heterocycles.
3. To understand the chemistry of carbohydrates and nucleic acids.
4. To learn the basics of biomolecules namely Amino Acids, Peptides, Proteins and Enzymes.
5. To learn the chemistry of oil and fats, surfactants and synthetic drugs.
6. To understand the basics, classifications, structures and applications of synthetic dyes and polymers.

Course Learning Outcomes: -

On completion of this theory course, students will-

1. Develop understanding of synthesis and application of organometallic compounds and also will gain knowledge of chemistry of amines.
2. Gain in-depth knowledge of structure, syntheses, and reactions of the simple 5 and 6-membered ring heterocycles, the benzene ring fused heterocycles.
3. Describe the classifications and structures of various carbohydrates and nucleic acids.
4. Explain chemistry of biomolecules namely Amino Acids, Peptides, Proteins and Enzymes.
5. Describe properties, structure and applications of oil and fats, surfactants and synthetic drugs.
6. Gain in-depth knowledge of classifications, structures and synthetic applications dyes and polymers.

Course Contents: -

Unit I: (10 Hrs)

A. **Organometallic compounds**

Organo-Magnesium compound: Grignard reagent, formation (from alkyl and aryl halide) and chemical reactions with carbonyl compounds, esters, alkyne and dry ice.

Organo-Zinc compounds: Formation (from ethyl bromide) and its Reformatsky reaction.

Organo-Lithium compounds: Formation of methyl and n-butyl Lithium and its use as base.

B. **Amines:** Structure and stereochemistry of amines, separation of mixture of 1°, 2° and 3° amines, basicity of amines, structural features affecting basicity of amines, preparation of alkyl & aryl amines: reduction of nitro compounds and nitriles, reductive amination of aldehydic and ketonic compounds, Gabriel phthalimide reaction, Hofmann bromamide reaction. Reactions of amines: Preparation and synthetic transformations of aryl diazonium salts (Coupling with β-naphthol and Sandmeyer reaction). Picric acid- preparation and uses.

Unit II: (10 Hrs)

Heterocyclic Compounds:

A. Introduction, 5-membered heterocyclic rings- Molecular orbital structure and aromaticity of furan, pyrrole, thiophene. Pyrrole: Synthesis from acetylene, succinamide and furan, Electrophilic substitution reaction (orientation)- sulfonation, halogenation, nitration and acylation.

B. 6-membered heterocyclic ring – Pyridine: Molecular orbital structure and aromaticity, Synthesis (from Hantzsch methods, acetylene and pentamethylene diamine hydrochloride), Orientation and general mechanism of electrophilic and nucleophilic substitution reaction of pyridine (Chichibabin and hydroxylation reaction). Comparison of basicity of pyrrole and pyridine

C. Introduction to fused ring (five and six) membered heterocycles. Preparation of Indole (by Fischer Indole synthesis), Quinoline (by Skraup synthesis) and Isoquinoline (by Bischler Napieralski synthesis).

Unit III: (10 Hrs)

A. **Carbohydrates:** Definition, classification and reaction of glucose. Mechanism of osazone formation, Determination of structure of glucose. Determination of ring size of monosaccharides. Epimerisation, mutarotation, conversion of glucose into fructose and vice-versa. Chain lengthening and shortening of aldoses (Wohl's degradation). Introduction to structures of maltose, sucrose, lactose, starch, cellulose, ribose and deoxyribose without involving structure determination.

B. **Nucleic Acids:** Introduction, constituents of nucleic acids, nitrogen bases, nucleosides and nucleotides, structures of Ribonucleic acid and Deoxyribonucleic acid.

Unit IV: **(10 Hrs)**

A. Amino Acids, Peptides and Proteins

Classification, structure and stereochemistry of amino acids. Zwitterions, pKa values, Acids base behaviour, isoelectric point and electrophoresis. Synthesis and reactions of α-Amino Acids. Ninhydrin: structure and uses.

Study of peptides: determination of their primary structures-end group analysis, general methods of peptide synthesis. Reagent groups in peptide synthesis N-protecting, C-protecting and C-activating groups, Solid-phase synthesis.

Proteins-Classification, Protein denaturation, Structure determination (primary and secondary).

B. Enzymes

Introduction, classification and characteristics of enzymes, active site of enzymes, enzyme specificity, Promoters & Inhibitors, Enzyme catalysis, Kinetics of Enzyme Catalyzed Reactions-Machaelis-Menten Equation.

Unit V: **(10 Hrs)**

A. Fats and Oils

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, triglycerides, Analysis of oil and fats-Saponification value, Iodine value, Acid value. Reactions of oil and fats- Oxidation (Rancidification), Saponification, Hydrogenation.

B. Surfactants- Soap and its cleansing action, micelle formation, Synthetic detergents-Alkyl and aryl sulfonates.

C. Synthetic Drugs: Definition and its Classification. Preparation, properties and uses of-Aspirin, Paracetamol, Dettol, Chloroquine, Phenobarbitone, Chloramphenicol, Chloramine T.

Unit VI: **(10 Hrs)**

A. Dyes

Classification, Theories of Colour and constitution, Mordant and Vat Dyes, Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure and synthesis of Alizarin and Indigotin, Edible Dyes with examples.

B. Polymers

Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index. Polymerization reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerization of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

References:

1) Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
2) McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
3) Sykes, P. A. Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
4) Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
5) Singh J. and Yadav L.D.S.; Undergraduate Organic Chemistry Volume I, II and III.
6) Pradeep's Organic Chemistry, Volume 3.
7) Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
8) Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
9) RM Silverstein, G C Bassler and TC Morril, John Wally Spectroscopic identification of organic compound
10) Tadashi Okuyama and Haward Maskill, Oxford organic chemistry, a mechanistic approach (oxford)
11) Hashmat Ali, Reaction mechanism in organic chemistry (S-chand publications)
12) Gautam Bramhachari, Organic chemistry through solved problems (Narosa publications)
13) Gautam Bramhachari , Organic name reactions, a united approach (Narosa publications)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI (NEP)

SUBJECT – CHEMISTRY (Major – DSC VII)

UCH360P: (Organic Chemistry Practical)

[60 Hrs] **[2 Credits]**

Course Description: -

This course is designed to develop practical skills among the students related to methods of quantitative and qualitative analysis of organic compounds. These skills related to quantitative estimations of organic compounds and Qualitative analysis of binary organic mixture will boost their confidence to work in industries.

Course Objectives: -

The primary objective of the practical course is

1. To learn the quantitative estimations of certain organic compounds like glucose, acetamide, glycine, carboxylic acid.
2. To learn the determination of saponification value of oil.
3. To learn the qualitative organic analysis of an organic mixture containing two solid components.
4. To learn the preparation of suitable derivatives of organic compounds.

Course Outcomes: -

On completion of the practical course students will-

1. Gain the method of the quantitative estimations of certain organic compounds like glucose, acetamide, glycine, carboxylic acid.
2. Determine the saponification value of oil.
3. Develop understanding of qualitative organic analysis of an organic mixture containing two solid components.
4. Gain the method of preparation of suitable derivatives of organic compounds.

Contents:-

A. Quantitative Organic Estimations

1. Estimation of Glucose
2. Estimation of Acetamide
3. Estimation of Glycine
4. Estimation of Carboxylic group
5. Saponification value of oil

B. Qualitative Organic Separations

Separation of an organic mixture containing two solid components using Aq. $NaHCO_3$ or Aq. NaOH or Aq. HCl solution, identification of the components and preparation of suitable derivatives (minimum six mixtures)

Reference books:

1) Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2) Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3) http://nsdl.niscair.res.in
4) http://ocw.mit.edu

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI

SUBJECT – CHEMISTRY (Major – DSC VIII)

UCH365T: (Spectroscopy)

[60 Hrs] **[4 Credits]**

Course Description: -

The purpose of this course is to introduce learners with knowledge of the branch of spectroscopy. The fundamental principles behind various spectroscopic techniques and their application in determining the molecular structure form the major portion of this course. The units are designed to cover important topics of microwave, vibrational, Raman, UV-visible, NMR spectroscopies and mass spectrometry.

Course Objectives: -

1. To learn the fundamentals of the branch of spectroscopy and the principles of rotational spectroscopy.
2. To understand the basics of infrared absorption spectroscopy and its applications by analysis of spectral data.
3. To study the laws of UV-visible spectroscopy and learn its applications.
4. To understand the principles of Raman spectroscopy and mass spectrometry.
5. To learn the details of basic principles of ^{1}H NMR spectroscopy and understand structure elucidation using NMR spectrum.

Course Learning Outcomes: -

On completion of this theory course, students will-

1. Develop a profound understanding of the basics of spectroscopy and the principle behind rotational spectroscopy.
2. Gain in-depth knowledge of infrared absorption spectroscopy and its applications by analysis of spectral data.
3. Apply the UV-visible spectroscopy to study electronic transitions and molecular structures.
4. Explain the Raman effect, its theory and principle of mass spectrometry.
5. Describe the fundamental concepts of Nuclear Magnetic Resonance spectroscopy and apply its principles to interpret spectral data for structure elucidation.

Contents: -

Unit I: **(10 Hrs)**

A) Introduction to Spectroscopy: Interaction of electromagnetic radiation with molecules, different types of various types of spectra; Born-Oppenheimer approximation**.** Characteristics of electromagnetic radiation - wavelength, wave number, frequency, energy and their inter-relationships. Numericals.

B) Rotational Spectroscopy: Types of rotating molecules, Dipole moment and Rotational Spectra. Rotational spectra of diatomic molecules, Energy levels of rigid rotor. Selection rule for transition between energy levels. Expression for wave number (cm^{-1}) of spectral lines in terms of rotational constant (B) and rotational quantum number (J). Intensity of spectral lines. Application of rotational spectra for determination of bond length of diatomic molecules.

Unit II: Infrared (IR) absorption spectroscopy: (10 Hrs)

Energy levels of simple harmonic oscillator, Energy level diagram, relative populations of energy levels. Selection rule for pure vibrational spectra (harmonic oscillations), Force constant. Anharmonic oscillator, Morse equation, selection rules, idea of overtones. Degrees of freedom and normal modes of vibration for CO_2, H_2O molecules. Intensity and position of IR bands, measurement of IR spectrum. Fingerprint region, characteristic absorptions of various functional groups and application of IR spectra.

Unit III: UV-Visible spectroscopy: (10 Hrs)

Introduction to spectroscopy, electromagnetic spectrum, Absorption spectra, Ultraviolet absorption spectroscopy, Absorption laws (Beer-Lambert law), molar absorptivity, Presentation and analysis of UV spectra, Types of electronic transitions, Effect of conjugation (HOMO-LUMO), concept of chromophores and auxochromes, Bathochromic, hypsochromic, hyperchromic and hypochromic shifts. Applications of UV –Visible spectroscopy, analysis of UV–Visible spectra of conjugated dienes and enones.

Unit IV: (10 Hrs)

A) Raman spectroscopy: Raman effect, Quantum Theory of Raman Effect, Qualitative treatment of Rotational-Raman effect, Vibrational-Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion, Comparison with rotational spectra.

B) Mass spectrometry:
Principle of Mass spectrometry, ion production, ion analysis, ion abundance, isotopic contribution, N- rule, types of fission processes, metastable peak, molecular ion peak, McLafferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry.

Unit V: NMR spectroscopy I: (10 Hrs)

Nuclear Magnetic Resonance (NMR) spectroscopy (^1H NMR) : Introduction, spin active nuclei, ^1H or proton magnetic resonance, theory and principle, instrumentation, relaxation phenomenon, nuclear shielding and deshielding, chemical shift, factors affecting chemical shift, concept of magnetic anisotropy, equivalent and non-equivalent protons, solvents and internal standard-TMS.

Unit VI: NMR spectroscopy II (10 Hrs)

Nuclear Magnetic Resonance (NMR) spectroscopy (^1H NMR): Spin-spin splitting and coupling constant. Intensities of signals, Pascal's triangle, Interpretation of NMR spectra of organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,2 dibromoethane, ethyl acetate, toluene, acetophenone, acetyl acetone.

Reference books:

1] Spectroscopic identification of organic compound-RM Silverstein, GC Bassler and TC Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiley
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Practical NMR Spectroscopy-ML Martin, J. J. Delpench, and DJ Martyin
7] Spectroscopic Methods in Organic Chemistry-D. H. Willson, I Fleming
8] Fundamentals of Molecular Spectroscopy-C.N. Banwell
9] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro
10] Elementary Organic Spectroscopy-Y. R. Sharma, S. Chand.

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI

SUBJECT – CHEMISTRY (Major – DSC VIII)

UCH365P: Spectroscopy Lab Course

[60 Hrs] **[2 Credits]**

Course Description: -

The purpose of this course is to make students able to interpret spectral data. The learners will develop skills to elucidate the structure of a compound from the data of various spectroscopic studies. They will be able to corelate data from different spectroscopic techniques and use it for deducing the structure of a compound.

Course Objectives: -

The primary objective of the practical course is to learn to obtain and interpret the spectral data of the given compound or solution.

1. To study absorbance spectra of given compounds and calculate their transition energies.
2. To study the effect of pH on the absorbance of the solutions.
3. To correlate the structure of organic compounds and their spectra.
4. To identify the structure of organic compounds from the given Mass, IR and NMR data.

Course Outcomes: -

On completion of the practical course students will-

1. Gain an understanding of the application of UV-Visible spectroscopy to calculate transition energies.
2. Explain the effect of pH on UV-Vis spectrum.
3. Comment on the effect of structure on the UV spectra of various organic compounds.
4. Interpret the spectral data obtained using Mass, IR and NMR spectroscopy to identify the organic compound.

Contents:-

1. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1} , cm^{-1}, eV).
2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$
3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of various organic compounds.
4. Identification of simple organic compounds (Minimum 12 compounds) by IR spectroscopy, NMR Spectroscopy and mass spectrometry. (Spectra to be provided).

Reference books:

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC

Morril, John Wally
2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely
3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall
4] Organic Spectroscopy-William Kemp, ELBS with McMillan
5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi
6] Practical NMR Spectroscopy-ML Martin, J. J. Delpench, and DJ Martyin
7] Spectroscopic Methods in Organic Chemistry-D. H. Willson, I Fleming
8] Fundamentals of Molecular Spectroscopy-C.N. Banwell
9] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Discipline Specific Elective (DSE) of Major

Semester VI course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI

SUBJECT – CHEMISTRY (Elective – DSE II – First)

UCH364T – Instrumental Methods of Analysis

Course Description:

This course offers an in-depth overview of instrumental methods used in chemical analysis, emphasizing the principles, instrumentation, and applications of various analytical techniques. Students will learn to select appropriate methods for different sample types, operate and maintain analytical instruments, and interpret the resulting data. The course covers spectroscopic, chromatographic, electrochemical & thermal analysis techniques.

Course Objectives:

1. To provide a comprehensive understanding of various instrumental techniques used in chemical analysis.
2. To develop the ability to choose appropriate analytical methods for different types of samples.
3. To gain hands-on experience in using modern analytical instruments.
4. To understand the principles and applications of spectroscopic, chromatographic, electrochemical, and other instrumental techniques.
5. To interpret analytical data and troubleshoot common issues in instrumental analysis.

Course Outcomes:

On completion of the course students will be able to-

1. Demonstrate knowledge of the principles and applications of major instrumental techniques.
2. Select appropriate analytical methods for specific chemical problems.
3. Operate and maintain analytical instruments.
4. Analyze and interpret data obtained from instrumental methods.
5. Apply instrumental techniques to real-world problems in various fields, such as environmental, pharmaceutical, and materials science.

Contents:

Unit I: Introduction to Instrumental Methods of Analysis (10 Hrs)

Overview of analytical methods: qualitative and quantitative analysis. Comparison of classical and instrumental methods. Advantages and limitations of instrumental methods. Types of instrumental techniques: spectroscopic, chromatographic, electrochemical, thermal, and others.

Unit II: Optical methods of analysis I (10 Hrs)

Colorimetry and Spectrophotometry

Principles of photometry: Beer-Lamberts Law, derivation and deviation (Numericals). Types of colorimeters and spectrophotometers, single & double beam spectrophotometer - detail

instrumentation with simple schematic diagrams. Application of colorimeter and spectrophotometer in quantitative analysis.

Unit III: Advanced Separation Techniques I (10 Hrs)

Gas Chromatography

History and development of gas chromatography. Basic theory of gas chromatography. Partition coefficient and distribution of analytes between stationary and mobile phases. Instrumentation: Components of a gas chromatograph, Carrier gas, sample injection system, chromatographic column, detector, and data acquisition system. Types of carrier gases and their selection. Sample injection techniques. Types of columns, their advantages and limitations. Detectors in GC analysis. Factors affecting retention, peak resolution and peak broadening**.**

Unit IV: Advanced Separation Techniques II (10 Hrs)

Liquid Chromatography

History and development of HPLC. Normal phase & reverse phase chromatography. Principle, Instrumentation, Advantages and applications of HPLC. Types of pumps, types of columns and detectors. Principle and applications of size exclusion, gel permeation, ion retardation, normal phase and reverse phase chromatography.

Unit V: Diffraction Techniques (10 Hrs)

History and development of XRD. Recapitulation of basics of crystallography. Instrumentation: X-ray generation: X-ray tubes and synchrotron sources, Components of an XRD instrument: monochromators, detectors, goniometers, Sample preparation techniques. Data Acquisition and Analysis: Methods of data collection: powder XRD, single-crystal XRD Interpretation of diffraction patterns.

Unit VI: Thermal Methods of Analysis (10 Hrs)

A. Introduction to different thermal methods, Thermogravimetry (TG and DTG), Static thermogravimetry, quasistatic thermogravimetry and dynamic thermogravimetry, Instrumentation-Balances, X-Y recorder, Stanton-Redcroft TG-750, Thermogram, Factors affecting thermogram, Applications of thermogravimetry,

B. Differential Thermal Analysis (DTA) - Theories, DTA curves, Factors affecting DTA curve, Applications of DTA, simultaneous determination in thermal analysis,

C. Differential Scanning Calorimetry (DSC)- Introduction, Instrumentation, DSC curves, factors affecting DSC curves, applications..

List of Books

1. Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
2. Fundamentals of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, F. James Holler, and Stanley R. Crouch.
3. Analytical Chemistry by Gary Christian, Kevin A. Schug, and Purnendu Dasgupta.
4. Vogel's Textbook of Quantitative Analysis by G H Jeffery, J Basssett.
5. Spectrophotometry and Spectrofluorimetry" by Michael G. Gore
6. Introduction to Spectroscopy" by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan.

7. Introduction to Modern Liquid Chromatography" by Lloyd R. Snyder, Joseph J. Kirkland, and John W. Dolan.
8. Chromatography: Concepts and Contrasts" by James M. Miller.
9. High-Performance Liquid Chromatography" by Sandie Lindsay.
10. Practical High-Performance Liquid Chromatography" by Veronika R. Meyer.
11. Elements of X-ray Diffraction" by B.D. Cullity and S.R. Stock.
12. X-ray Diffraction: In Crystals, Imperfect Crystals, and Amorphous Bodies" by A. Guinier.

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI (NEP)

SUBJECT – CHEMISTRY (Elective – DSE – II – Second)

UCH364T – Cheminformatics

[60 Hrs] **[4 Credits]**

Course Description: -

The objective of this course is to provide introduction to cheminformatics, an interdisciplinary area on the interface of chemistry and informatics. The student will be provided with an understanding of the fundamentals of cheminformatics and its applications. Through lectures and assignments, the student is expected to achieve a good grasp of the concepts and applications of cheminformatics.

Course Objectives: -

1. To understand the fundamentals of cheminformatics.
2. To understand the basics of small molecule library construction and constraints involved in virtual screening
3. To learn the important concepts of quantum mechanics.
4. To understand the basics of molecular mechanics.
5. To learn molecular simulation dynamics.
6. To understand the fundamentals of drug design.

Course Learning Outcomes: -

On completion of this theory course, students will-

1. Explain basic concepts of cheminformatics.
2. Perform virtual screening with chemical compound databases to find the scaffold structure for drug.
3. Explain important concepts of quantum mechanics.
4. Describe the basics of molecular mechanics.
5. Relate the molecular simulation dynamics.
6. Elaborate drug design basics.

Contents

UNIT I: INTRODUCTION TO CHEMINFORMATICS (10h)

An Outline about Cheminformatics, What You Can Do with Cheminformatics? Open-Source Tools, Techniques, and Data in Cheminformatics.

UNIT II: DESIGN AND SCREENING OF FOCUSED VIRTUAL LIBRARIES (10h)

Introduction to Structure, Property Correlations, Descriptors- Online Property Prediction Tools, Virtual Library Generation (Enumeration), Virtual Screening- Thumb Rules for Computing Molecular Properties, Molecular docking

UNIT III: QUANTUM MECHANICS (10h)

Introduction, coordinate systems, potential energy surfaces, introduction to quantum mechanics – postulates, Schrodinger wave equation, hydrogen molecule, Born-Oppenheimer approximation, introduction to computer hardware and software.

UNIT IV: MOLECULAR MECHANICS (10h)

Features of molecular mechanics, force fields; Bond structure and bending angles electrostatic, van der Waal's and non –bonded interactions, hydrogen bonding; Derivatives of molecular mechanics energy function; Application of energy minimization

UNIT V: MOLECULAR DYNAMICS SIMULATION (10h)

Molecular Dynamics using simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Time dependent properties; Solvent effects in Molecular Dynamics; Conformational changes from Molecular Dynamics simulation and application.

UNIT VI: DRUG DESIGN (10h)

Introduction, History of Drug Development, drug development time lines, stages of drug discovery, strategic issues in drug discovery, emerging approaches to drug design and discovery, drug metabolism physicochemical properties, Basic pharmacodynamics and pharmacokinetics.

References:

1. 1. Andrew Leach - Molecular Modelling: Principles and Applications, 2nd Edition. Pearson Education EMA, 2001.
2. Rick NG. Drugs: from Discovery to Approval, John Wiley & sons. 2004
3. Andrew R Leach, Valerie J Gillet, An Introduction to cheminformatics, Kluwer Academic publishers. 2003.
4. Cheminformatics: A Textbook; Publisher: John Wiley & Sons Ltd; Edition Year: 2005
5. Concepts in Pharmacogenomics; Publisher: American Society of Health System Pharmacists; Edition Year: 2010
6. Drug Design: Structure and ligand based approaches: Kenneth M.Merz, Dagmar Ringe, Charles H.Reynolds

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

Vocational Skill Course (VSC)

Semester VI course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI (NEP)

SUBJECT – CHEMISTRY (Elective – VSC – IV)

U361VSC– Analytical Techniques in Pharmaceutical, Cosmetic, and Food Chemistry

Course Objectives:

1. To prepare aspirin and ORS powder in the laboratory.
2. To analyse commercial vitamin C tablets.
3. To prepare cosmetic products like cold cream, vanishing cream, calamine lotion, face powder, and zinc starch and talc dusting powder.
4. To estimate the moisture content in food products.
5. To isolate natural products like casein and lactose from milk, caffeine from tea leaves, β-carotene from carrot, and limonene from citrus rinds.

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Course Outcomes:

At the end of the course, student will be able to:

1. Prepare aspirin and analyse in the laboratory.
2. Prepare ORS powder.
3. Analyse commercial vitamin C tablets.
4. Prepare cosmetic products like cold cream, vanishing cream, calamine lotion, face powder, and zinc starch and talc dusting powder.
5. Estimate the moisture content in food products.
6. Isolate natural products like casein and lactose from milk, caffeine from tea leaves, β-carotene from carrot, and limonene from citrus rinds.

Practicals:

1. Preparation of aspirin and its analysis.
2. To prepare the ORS powder.
3. Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry.
4. To prepare cold cream.
5. To prepare vanishing cream
6. To prepare calamine lotion
7. To prepare face powder.
8. To prepare the zinc starch and talc dusting powder.
9. Determination of moisture in food products by hot air oven-drying method.
10. Isolation of casein from milk.
11. Isolation of lactose from milk.
12. Isolation of caffeine from tea leaves.
13. Isolation of β-carotene from carrots.
14. Isolation of limonene from citrus rinds.

References:

1. A. l. Vogel, Practical Qualitative and Quantitative Organic Chemistry (Orient Longman)

2. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan.

3. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.

4. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

5. Perry Romanowski, Beginning Cosmetic Chemistry, Allured Pub Corp.2009.

6. Dr. Ramesh Kumari, Chemistry of Cosmetics, Prestige Publishers.

7. Srilakshmi B., Food Science, New age International Pvt. Ltd. Publishers, III ed. 2003.

8. Shakuntala Manay N. and Shadaksharaswamy M. FOODS: Facts and Principles. New Age International Pvt. Ltd. Publishers, II ed. 2002.

9. Norman N. Potter, Food Science, CBS publishers and distributors, New Delhi. 1994.

10. Jagdamba Singh, R.K.P. Singh, Jaya Singh, L.D.S. Yadav, I.R. Siddiqui, Jaya Srivastava, Advanced Practical Chemistry, Pragati Publication.

Shiksha Mandal's

Bajaj College of Science, Wardha

(An Autonomous Institution)

Department of Chemistry

Proposed Syllabus for Four Year B.Sc. Honors with Chemistry as Major

On-The-Job-Training (OJT) of Major

Semester VI course in
Chemistry

Syllabus under Autonomy

(Approved in BOS Meeting of 11-March-2025 to be implemented from Academic Session 2025-26)

Shiksha Mandal's

Bajaj College of Science, Wardha

Syllabus of B.Sc. III Semester VI (NEP)

SUBJECT – CHEMISTRY

UCH367P – On-The-Job-Training (OJT)

[60 Hrs.] **[2 Credits]**

Course Objectives:

1. To improve students' understanding of the experiences, challenges, and opportunities of the real world of work.
2. To set students' expectations and behaviour in accordance with the demands, culture, and values of current and emerging jobs.
3. To make students understand the application of their knowledge and skills while working in industry, corporate, research & development organizations, workplace, within or outside of the college.
4. To provide exposure to emerging technologies/ automation and how it can support, facilitate, improve and reinforce work processes/ culture/ job roles/art and craft/ agriculture, etc.
5. Understand how organizations / enterprises are formed for sustainable progress so that start-ups and entrepreneurial capabilities are strengthened among students, and they are encouraged to be job creators.
6. To develop problem-solving and decision-making skills, enable teamwork & collaboration culture to promote research, academic and professional developments.
7. To develop a sense of social imagery and an attitude towards citizenship responsibility.

Course Outcomes:

At the end of the course, students will be able to:

1. Apply theoretical knowledge to real-world industrial, corporate, and research settings by analyzing challenges and opportunities encountered during the training.
2. Exhibit professional behavior, ethics, and adaptability to the demands, culture, and values of modern workplaces.
3. Utilize chemistry-related concepts, laboratory skills, and problem-solving abilities effectively in industrial processes, R&D activities, and workplace operations.
4. Evaluate the role of emerging technologies, automation, and digital tools in optimizing work efficiency across various industries, including research, agriculture, and manufacturing.
5. Assess organizational structures, business models, and sustainability practices to develop entrepreneurial competencies and explore startup opportunities
6. Demonstrate teamwork, leadership, and decision-making abilities in collaborative projects, fostering a research-oriented and professional development mindset.
7. Develop a sense of social responsibility, ethical conduct, and civic engagement to contribute positively to society and sustainable development.

Guidelines:

As per NEP 2020, students of BSc Semester VI (Third Year-Second Semester) students need to undertake On-The-Job-Training (OJT) for **TWO (2) Credits** i.e. **50 Marks**. The guidelines regarding the OJT are as follows:

1) The candidate must undergo a 60-hour on-the-job training/internship/apprenticeship in the Industry/Health Sectors/Research Laboratories/Public Testing Laboratories/Health Diagnostic Laboratories.
2) During the term of on-the-job training (OJT), the candidate is required to regularly submit weekly reports on their progress and attendance in the specified format to the Head or Coordinator of the relevant Institute.
3) Students are required to submit the OJT/Field report within 15 days after finishing the OJT. The report should not exceed 20 pages.
4) The candidate must adhere to the guidelines provided by the relevant industry or institute. Any misconduct by the student during the OJT may result in severe consequences.
5) Students are required to independently fulfill their responsibilities of completing their OJT.
6) Students are required to submit their parents' undertakings in the prescribed format to the relevant department prior to commencing their OJT.
7) Students must submit GPS tagged photos at OJT centre/institute/company to the PG coordinator on any two days of OJT activity. The photo should be taken during office hours. Students must respond to respective mentor teachers of the department upon requirement.
8) Students are expected to actively interact with their allocated mentors or supervisors during the duration of the course. Frequent engagement facilitates a more comprehensive comprehension of assignments, industry norms, and cultivates an environment that is conducive to learning.
9) Students should regularly solicit feedback to evaluate their own development and identify areas requiring improvement.
10) Students are advised to keep a comprehensive notebook or record throughout their on-the-job training (OJT). The documentation should encompass a comprehensive record of the daily undertakings, difficulties encountered, acquired knowledge and perspectives. Promoting the practice of thoughtful writing will assist in efficiently combining experiences and achieving desired learning results.
11) The scheme of examination for field project is given below –

Sr. No	Evaluation type	Marks
1	Presentation	20
2	Report	50
3	Mentor’s Assessment	30
Total Marks		**100**